MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XXI. *Dec.* 14, 1860. No. 2.

The Rev. R. MAIN, President, in the Chair.

Sir Charles Tilstone Bright, 12 Upper Hyde Park Gardens, was balloted for and duly elected a Fellow of the Society.

On a Method for determining Longitude by means of observations on the Moon's greatest Altitude. By William Spottiswoode, Esq., M.A., F.R.S., &c. (Abstract.)

The object of the present investigations is to suggest a method whereby, at certain parts of the moon's orbit, and under favourable circumstances, the longitude may be determined by means of a simple sextant observation. The method does not attain to the same degree of accuracy as some others already in use; nor can it be successfully applied except when the moon's motion in declination is considerable; and the observation, being restricted in time to the immediate vicinity of the greatest altitude, is very dependent on weather. For the traveller supplied with proper instruments, the eclipses of *Jupiter's* satellites will, doubtless, always furnish one of the best means of determining the longitude; and for one carrying only a sextant, the method of lunar distances is superior to all others; but the labour of the latter observations is such as to render them practicable only at rare intervals on a journey, while the complexity of the calculations almost precludes the possibility of obtaining satisfactory results until the data have been sent home. A method, therefore, in which both observation and calculations are simple may not be without use, either as supplementary to more elaborate processes, or as a substitute when

they are not practicable; and the following is suggested for the use of the traveller as a check to his dead reckoning, after the last of his chronometers has broken down, and when results from lunar distances are not attainable.

The method consists in determining the moon's declination at the time of the greatest altitude. This being ascertained, if the local time be known, we have merely to compare the Greenwich time, deduced from the *Nautical Almanac*, at which she has that declination; the difference in times is of course the longitude expressed in time. If, however, the local time be not known, a formula deduced from the same data, and given in the memoir, determines the hour-angle at the time of the greatest altitude. By means of this, the correction to be applied to the moon's declination at the time of observation, in order to reduce it to that on the meridian, may be calculated; and a comparison of the declinations at her meridian passage at the place and at Greenwich, with the aid of the table of differences of declination in the *Nautical Almanac*, will give the longitude.

On the Distribution of the Perihelia of the Parabolic Comets in relation to the Motion of the Solar System in Space. By R. C. Carrington, Esq. (Abstract.)

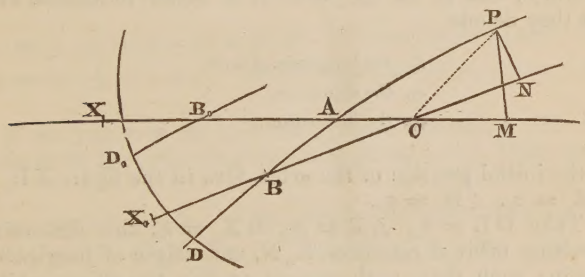
Inquiries into the direction and amount of the motion of the solar system have hitherto been entirely based upon the consideration of the residual small motions of what were once termed the fixed stars; and although the results for direction now exhibit a progressively increasing agreement and certainty, it is always desirable, where the case admits of it, to endeavour to obtain an independent result by approaching the subject from a different point of view. The bearing which the distribution of comets has on the matter was suggested by the observed horary variation in the number of meteors, and the explanation of the probable cause of this variation, given by M. Bompas in the *Monthly Notices* for Jan. 1857, by reference to the orbital motion of the earth. A like idea applies to the distribution of the parabolic comets, and the proposition stands thus:

If the comets moving in unclosed orbits be chance visitors, and if the conditions of visibility on the whole affect the discovery of all alike, it would be expected that, were the Sun at rest, the perihelia would be found equally scattered through the heavens; but if the Sun be in motion, as we now hold it to be, from α *Columbæ* to π and μ *Herculis*, then there would be found a certain excess of perihelia in the hemisphere of which

α Columbæ is the pole, and a certain condensation about that region, so that if for each orbit the angle were computed between *α Columbæ* and the comet's perihelion, the mean of these angles would be less than 90°. This is tested by the tables annexed to the memoir. It appears that out of the 133 parabolic and hyperbolic orbits considered, the perihelia of 61 lie in the hemisphere from which, and of 72 in the hemisphere to which, the sun is assumed to be moving; the mean angular distance between *α Columbæ* and each perihelion coming out 95° 36′, a result which superior evidence shows must be regarded as nugatory and vitiated by uncontrolled conditions, among which the principal is probably the unequal distribution of discoverers of comets in the northern and southern hemispheres of the earth.

On some Formulæ relating to the Variation of the Plane of a Planet's Orbit. By A. Cayley, Esq.

In Hansen's Memoir, "Auseinandersetzung einer zweckmässigen Methode zur Berechnung der absoluten Störungen der kleinen Planeten," Abh. der k. Sächs. Gesell. t. v. (1856), are contained, § 8, some very elegant formulæ for taking account of the variation of the plane of the orbit. These, in fact, depend upon the following geometrical theorem, viz., if (in the figure) A B C is a spherical triangle; P, a point on the side A B; and P M, P N, the perpendiculars let fall from P on the other two sides A C, C B; then we have



$$\cos PM \sin(BC + CM) = \cos PN \sin BN - \tan \tfrac{1}{2} C \cos BC (\sin PM + \sin PN),$$
$$\cos PM \cos(BC + CM) = \cos PN \cos BN + \tan \tfrac{1}{2} C \sin BC (\sin PM + \sin PN).$$

These equations, in fact, give

$$\cos PM \sin CM = \cos PN \sin CN - \tan \tfrac{1}{2} C (\sin PM + \sin PN),$$
$$\cos PM \cos CM = \cos PN \cos CN;$$

the latter of which is at once seen to be true, since joining the points C and P, the two sides are respectively equal to cos CP. To verify the former one, write $\angle PCM = C_1$, $\angle PCN = C_2$, so that $C = C_1 - C_2$. Then, since $\cos CP = \cos PM \cos CM = \cos PN \cos CN$, $\sin PM = \sin CP \sin C_1$, $\sin PN = \sin CP \sin C_2$, the equation becomes $\cos CP (\tan CM - \tan CN) = -\tan \frac{1}{2} C \sin CP (\sin C_1 + \sin C_2)$, or since $\tan CM = \tan CP \cos C_1$, $\tan CN = \tan CP \cos C_2$, this is

$$\cos C_1 - \cos C_2 = -\tan \tfrac{1}{2} C (\sin C_1 + \sin C_2),$$

which is identically true, in virtue of the equation $C = C_1 - C_2$; and, conversely, we have the original two equations.

Suppose that XM is the ecliptic, X being the origin of longitudes, DP the instantaneous orbit, D the departure-point therein, and P the planet, DD_0 the orthogonal trajectory of the successive positions of the orbit; and writing

$\flat$, the departure of the planet,
v, the longitude of ditto,
y, the latitude of ditto,
θ, the longitude of node,
σ, the departure of ditto,
φ, the inclination;

then, in the figure, $DP = \flat$, $XM = v$, $PM = y$, $XA = \theta$, $DA = \sigma$, $\angle A = \varphi$.

The quantities θ_0, σ_0, φ_0, might be considered as altogether arbitrary; but to fix the ideas it is better to assume at once that they denote

θ_0, the longitude of node,
σ_0, the departure,
φ_0, the inclination,

for the initial position of the orbit, viz., in the figure $XB_0 = \theta_0$, $D_0B_0 = \sigma_0$, $\angle B_0 = \varphi_0$.

Take $DB = \sigma_0$, $\angle B = \varphi_0$, $BX_0 = \theta_0$, this determines a travelling orbit of reference X_0N, and origin of longitudes X_0 therein; such that, with respect to this travelling orbit, the position of the planet's orbit is determined by

θ_0, the longitude of node,
σ_0, the departure of node,
φ_0, the inclination.

We have in the triangle ABC, $AB = \sigma - \sigma_0$, $\angle B = \varphi_0$,

$\angle A = 180° - \varphi$; and if the other parts of the triangle are represented by

$$\begin{aligned} BC &= \omega, \\ AC &= \theta_0 - \theta + \omega + \Gamma, \\ \angle C &= \Phi; \end{aligned}$$

then ω, Γ, Φ, are given in terms of $\sigma - \sigma_0$, φ_0, φ; and we have, moreover, $XC = \theta + AC = \theta_0 + \omega + \Gamma$, $X_0C = \sigma_0 + \omega$; that is, the position of the travelling orbit X_0N, and origin of longitudes X_0 therein, are determined by

$\theta_0 + \omega + \Gamma$, the longitude of node,
$\sigma_0 + \omega$, the departure of node,
Φ , the inclination.

Suppose that in reference to this travelling orbit and origin of longitudes therein, we have

v', the longitude of planet,
y', the latitude of ditto,

viz., in the figure $X_0N = v'$ (and therefore $BN = v' - \theta_0$), $PN = y'$.

Moreover, $BC + CM = BC + AM - AC = \omega + (v - \theta) - (\theta_0 - \theta + \omega + \Gamma) = v - \theta_0 - \Gamma$, hence the two equations are

$$\cos y \sin (v - \theta_0 - \Gamma) = \cos y' \sin (v' - \theta_0) - \tan \tfrac{1}{2}\Phi \cos \omega (\sin y + \sin y'),$$
$$\cos y \cos (v - \theta_0 - \Gamma) = \cos y' \cos (v' - \theta_0) + \tan \tfrac{1}{2}\Phi \sin \omega (\sin y + \sin y'),$$

or, as they may also be written,

$$\cos y \sin (v - \theta_0 - \Gamma) = \cos \varphi_0 \sin (\flat - \sigma_0) - \tan \tfrac{1}{2}\Phi \cos \omega (\sin y + \sin y'),$$
$$\cos y \cos (v - \theta_0 - \Gamma) = \cos (\flat - \sigma_0) + \tan \tfrac{1}{2}\Phi \sin \omega (\sin y + \sin y'),$$

or, if we put $s = \sin y + \sin y'$, then observing that $\sin y = \sin \varphi \sin (\flat - \sigma)$, $\sin y' = \sin \varphi_0 \sin (\flat - \sigma_0)$, these become

$$\begin{cases} \cos y \sin (v - \theta_0 - \Gamma) = \cos \varphi_0 \sin (\flat - \sigma_0) - \tan \tfrac{1}{2}\Phi \cdot s \cos \omega, \\ \cos y \cos (v - \theta_0 - \Gamma) = \cos (\flat - \sigma_0) + \tan \tfrac{1}{2}\Phi \cdot s \sin \omega, \\ \sin y \,[= \sin \varphi \sin (\flat - \sigma)] = -\sin \varphi_0 \sin (\flat - \sigma_0) + s, \end{cases}$$

which are, in fact, Hansen's formulæ (16), p. 75, the letters corresponding as follows, viz.,

v, $\flat$, y, σ, σ_0, θ, θ_0, φ, φ_0, Φ, Γ, ω (suprà) to
l, v, b, σ, h, θ, h, i, $-k$, 2π, Γ, ω (Hansen).

where, of course, the correspondence φ_0 to $-k$, shows that these angles are measured in a contrary direction. I had from Hansen's equations expected that the above formulæ would have contained $\sin y - \sin y'$ in place of $\sin y + \sin y'$.

2 *Stone Buildings, W. C., 4th Dec.* 1860.

Observations of Comet III. 1860. By W. Scott, Esq., Director of the Observatory of Sydney.

I send you herewith my latest determinations of the comet's position. The weather was too cloudy for observations during the whole of the time intervening, and for many days following.

The light of the comet was too faint and diffused to admit of satisfactory observations, as will appear from a comparison of the results.

Comet Observations, August 1860.

Greenwich Mean Time.	Star.	Comet — Star R.A.	Comet — Star Decl.
d h m s		m s	′ ″
Aug. 16 21 32 56·5	φ Centauri	7 34·25	−13 26
22 37 29·0	,,	7 43·50	10 39
22 48 51·5	,,	7 47·00	−10 46
17 21 46 44·5		10·25	1 33
49 39·5		14·00	2 18
52 39·5		13·00	2 9
55 29·25		14·25	2 22
58 8·75		13·00	2 15
22 1 6·25		13·25	1 59
3 59·25	Star of 7th or 8th magnitude. Approximate R.A. $1^h\ 3^m\ 59^m$ Decl. −42°·0. (? 42° 0′ S. Ed.)	14·50	1 48
7 1·75		16·00	2 13
9 45·00		15·75	2 7
12 35·5		15·75	2 23
14 58·5		15·75	2 24
20 48·75		16·25	1 57
23 25·0		16·75	2 8
27 2·5		16·50	1 55
29 53·0		17·00	1 57
33 0·0		17·25	2 4
37 45·5		18·00	2 11
41 30·5		19·00	1 51
45 37·5		20·00	2 2
49 1·0		19·00	3 1
53 53·0		20·25	2 0

Determination of Comet's Position, July 1860.

Greenwich Mean Time.	Star.	Comet — Star. R.A.	Comet — Star. Decl.
d h m s		m s	′ ″
July 27 22 27 16·0	Bris. 4134	7 47·0	— 0 57
22 45 7·5	,,	7 51·25	— 0 57
,,	Bris. 4136	7 27·75	4 48
,,	Bris. 4139	6 58·50	3 57
22 55 35·0	Bris. 4134	7 53·00	— 2 15
,,	Bris. 4139	6 58·25	2 4
,,	*a*	2 0·75	13 22
23 8 43·5	*a*	2 1·75	13 0
23 13 6·0	*a*	2 4·00	12 25
,,	*b*	—0 16·00	13 8
23 15 48·0	*b*	—0 14·75	13 13
23 45 43·5	*b*	—0 7·25	12 18
48 40·0	*b*	—0 6·50	11 20
53 32·5	*b*	—0 6·00	11 36
		∗—B. 4139	∗—B. 4139
	a	4 57·50	—11 18
	b	7 17·50	—11 58
2 21 14 11·0	Lacaille 5329	1 27·25	—11 58
17 59·0	,,	1 27·00	—12 23
31 1·0		1 30·00	—12 37
36 18·5		1 30·75	—13 19
42 0·0		1 32·00	—13 3
47 1·5		1 34·00	—12 58
51 23·5		1 33·00	—13 13
55 35·0		1 34·25	—13 29
22 0 1·5		1 35·25	—13 49
4 10·0		1 36·25	—13 50
8 13·5		1 37·00	—13 55
12 13·5		1 37·75	—14 14
16 20·0		1 39·25	—14 26
20 30·0		1 40·00	—14 41
24 38·0		1 40·75	—14 37
28 39·0	,,	1 42·25	—15 1

Observatory, Sydney, Sept. 19th, 1860.

Observations of the same comet (III, 1860) taken at Ascension Island by Mr. Frederick J. Krabbe, H.M.S. Meander, between the 4th and the 22d July, 1860, have been communicated to the Society by favour of the Lords Commissioners of the Admiralty. The observations are sextant ones of the distances of the comet from certain fixed stars.

Results of Meridional Observations of Small Planets, and Occultation of Jupiter's third Satellite, observed at the Royal Observatory, Greenwich, during the month of November, 1860.

(*Communicated by the Astronomer Royal.*)

Flora (8).

Mean Solar Time of Observation.	h m s	Apparent R.A. h m s	Apparent N.P.D. ° ′ ″
1860, Nov. 1	13 2 1·2	3 48 7·96	81 6 37·94
2	12 57 13·0	3 47 15·51	81 8 52·62
3	12 52 23·5	3 46 21·80	81 10 55·16
7	12 32 52·6	3 42 33·96	81 18 14·66
22	11 18 28·5	3 27 5·93	81 25 3·69

Metis (9).

Mean Solar Time of Observation.	h m s	Apparent R.A. h m s	Apparent N.P.D. ° ′ ″
1860, Nov. 2	6 42 9·3	21 31 10·24	111 37 0·60

Eunomia (15).

Mean Solar Time of Observation.	h m s	Apparent R.A. h m s	Apparent N.P.D. ° ′ ″
1860, Nov. 2	6 43 33·7	21 32 34·88	91 21 40·55
3	6 40 28·0	21 53 25·25	91 19 33·81

Psyche (16).

Mean Solar Time of Observation.	h m s	Apparent R.A. h m s	Apparent N.P.D. ° ′ ″
1860, Nov. 15	12 32 41·4	4 13 55·14	73 44 48·95
22	11 58 57·3	4 7 41·39	74 2 3·80

Fortuna (19).

Mean Solar Time of Observation.	h m s	Apparent R.A. h m s	Apparent N.P.D. ° ′ ″
1860, Nov. 1	12 15 50·6	3 1 49·80	73 28 40·73
2	12 10 59·6	3 0 54·55	73 33 40·38
3	12 6 8·2	2 59 58·94	73 38 43·45
7	11 46 40·5	2 56 14·20	73 59 13·43
15	11 7 54·0	2 48 53·86	74 39 37·96

Euterpe (27).

Mean Solar Time of Observation.		Apparent R.A.	Apparent N.P.D.
	h m s	h m s	° ′ ″
1860, Nov. 2	9 45 32·5	0 35 3·60	89 4 10·72
3	9 41 3·4	0 34 30·31	89 6 36·73

Amphitrite (29).

Mean Solar Time of Observation.		Apparent R.A.	Apparent N.P.D.
	h m s	h m s	° ′ ″
1860, Nov. 1	12 31 34·5	3 17 36·32	63 18 51·07
2	12 26 38·0	3 16 35·53	63 19 36·80
3	12 21 41·0	3 15 34·32	63 20 32·60
7	12 1 47·2	3 11 23·39	63 25 49·95
22	10 47 12·1	2 55 44·46	64 4 40·12

Minor Planet (59).

Mean Solar Time of Observation.		Apparent R.A.	Apparent N.P.D.
	h m s	h m s	° ′ ″
1860, Nov. 3	9 16 10·9	0 9 33·73	95 15 36·35
7	8 59 56·7	0 9 3·06	95 25 27·22

Occultation of Jupiter's Third Satellite.

Day of Observation.	Phenomenon.	Mean Solar Time.	Observer.
		h m s	
1860, Nov. 2	Occ. disapp. first cont.	13 15 50·6	D.
	,, last cont.	13 21 49·6	D.
	Occ. reapp. central bis.	17 1 43·7	A. D.
	,, last cont.	17 5 13·2	A. D.

At the reappearance the planet was very faint, in consequence of a fog prevailing.

The initials D. and A. D. are those of Mr. Donkin and Mr. Davis.

Minor Planet (60).

The name *Titania* has been given to this planet. The following is the later of two sets of elements computed by the discoverer, Mr. Ferguson (*Gould Ast. Journal*, No. 141).

Epoch 1860, Oct. 1, Washington M.T.

	° ′ ″	
Mean longitude	199 48 13·8	
Longitude of perihelion	158 6 45·7	Mean Equinox of Epoch.
Longitude of node	187 15 15·8	
Inclination	4 40 18·8	
Excentricity	11 27 10·2	
Log. mean distance	0·359725	
Mean motion	1024″·3	

A portfolio of drawings of Solar Spots, by the Rev. F. Howlett, presented by him to the Society, was exhibited at the Meeting. The following is an extract from a letter to Sir J. W. F. Herschel, which accompanied this valuable present:—

"The drawings I now have the honour of submitting to you illustrate (with intermissions, of course, of greater or less duration) the period comprised between 23d Nov. 1859, and 10th Nov. 1860, inclusive; and they consist of about 100 diagrams of the whole solar disk, as seen under a magnifying power of about 30 diameters, and also of some 130 more diagrams of the separate spots, or groups of spots, magnified commonly about 120 diameters.

"It may be seen that many of the drawings were taken at an early hour in the morning, more especially during the months of June, July, and August last past; not only on account of the sky having frequently been very clear and serene at such times, even during this last unusually wet and gloomy summer, but also because the inclination to the horizon of any fixed line on the sun's disk (such as the line of junction of two spots) changes but very slowly in the earlier hours of the forenoon, and is, in fact, for about an hour or so, nearly unaltered; and thus an excellent opportunity was afforded, at such times, for noting down the relative positions of the spots on the sun's disk at greater leisure and with greater accuracy than, with the rough micrometric appliances at my command, I could easily have done at any hour nearer to noon, when the change of the obliquity of the sun's axis to the vertical is very much greater.

"With respect to other points, perhaps of interest in connexion with these diagrams generally, I would remark that the most conspicuous outbursts of spots hitherto this year (so far, at least, as I myself have observed) occurred, firstly, between the 28th June and the 7th, or say 9th of July, as delineated in sheets Nos. xxiii., xxiv., and xxv., wherein also are presented, as well as my 'Dollond' of barely 3 inches aperture enabled me to investigate them, certain of the changes successively undergone by the groups more particularly lettered therein ζ and ε.

"The second principal outburst might be assigned, I think, to the period between 28th July and 8th Sept. (unless indeed the sun's rotation in rather more than twenty-five days may have brought some of the later June and earlier July groups again into sight, and which I certainly am inclined to think was the case), as shown in sheets Nos. xxviii. to xxxii. inclusive; wherein likewise are presented the series of changes undergone by group μ, for instance, in xxviii. and xxix., and still more by ϱ in xxxi. and xxxii. The spot θ in No. xxv. (which also was observable on the day of the solar eclipse in July last) is likewise rather worthy of notice.

"As regards the darkest part of the nucleus of a spot (so

frequently and so distinctly brought out by the Rev. Mr. Dawes' method of investigating them, as stated in your 'Outlines of Astronomy') this phenomenon was very apparent even without any such method, in the spot β of 23d Nov. 1859, in sheet No. ix.; and again, on the 4th and 7th Sept. 1860, in the right-hand nucleus of spot ε, in No. xxxii.

"The large spot ζ, of 1st July, 1860, presented a very singular step-like appearance (No. xxiii.). At this period also, as well as on the 28th and 29th June, I observed a nucleus in this group more nearly approaching in form those curious wedge-shaped ones which were represented in my drawings of 28th August, 1859, than any others which have occurred, I believe, since the date just mentioned. The changes undergone by the group ζ, between its first appearance about 27th June and its disappearance, were very striking, more especially in the interval between the 1st and 2d July (see sheets xxiv. and xxv.)

"On the 22d June I noticed near the western limb of the sun a facula which appeared to extend, in a wavy continuous streak, to a length of at least 150,000 miles on the sun's surface, as faintly indicated in the disk of that day in No. xxii.

"The predominance of spots in the sun's northern hemisphere was, perhaps, not so decided this year as usual, though it was sufficiently marked during the great outburst in June and July last."

And appended to the letter was an account of the method adopted for noting down the positions of the spots on the disk; the co-ordinates employed are, in fact, those of Pastorf, viz., the distances in two directions at right angles to each other, of the point from the circumference of the disk. It has already been remarked by Mr. Carrington that the employment of such co-ordinates is anything but convenient.

There were exhibited at the Meeting four photographs of the Sun during the Eclipse of the 18th July, 1860, obtained at Desierto de las Palmas in Spain, by M. Monserrat, Professor of Chemistry at the University of Valentia, with the telescope by Cauchoix of the Observatory of the Collegio Romano, brought by the Director, P. Secchi. The photographs were communicated to the Astronomer Royal by Signor Aguilar, the Director of the Madrid Observatory.

At the Meeting in November were exhibited two lithographic drawings of Nebulæ, accompanied with a printed

description, presented by Mr. Lassell. The one of them represented the Annular Nebula in *Lyra*, R.A. $18^h\ 48^m{\cdot}4$, N.P.D. $57°\ 8'$, as seen in the 4-foot equatoreal, power 174, the field of view being about $5''{\cdot}68$ in diameter, the scale of the drawing was $1'' = 0{\cdot}015$ inch. The greater axis of the nebula is about $89'$, and the lesser about $68''$, by micrometrical measurement. The other drawing was a representation of the "Dumb Bell" Nebula, as seen with the 4-foot equatoreal, and the same power and field of view as was employed in the drawing of the Annular Nebula of *Lyra*.

RECENT PUBLICATIONS.

Recueil de Mémoires des Astronomes de l'Observatoire Centrale de Russie, publié avec l'autorisation de l'Académie des Sciences, t. II. Pet. 1859.

The first volume of this Collection, published 1853, and containing various important memoirs by MM. Struve, Peters, Döllen, Lindhagen, O. Struve, and Liapounov, is well known to astronomers. The present and concluding volume contains memoirs by M. O. Struve on the chronometrical expeditions in the years 1845 and 1846, and on the geographical positions determined by Lieut.-Col. Lemm, in 1847 in the country of the Don Cossacks, and in 1848 in the Government of Novgorod; the volume contains also the Pulkova observations of Biela's comet in the year 1852, with two plates of the comet as seen on the 20th Sept. and the 25th Sept. 1852; for a notice of these observations see *Monthly Notices*, vol. xvi. p. 137. M. O. Struve in the preface states that in consequence of the new regulations adopted by the Academy of Sciences at St. Petersburg, the collection will cease to appear in its actual form, but that a fixed number of copies of the astronomical memoirs will be put at the disposition of the Central Observatory, and that the scientific establishments, and Russian and foreign *savans*, who have received from the Observatory the two volumes of the Collection, will receive each separate astronomical memoir as it is printed, and that the works of the Russian astronomers will thus be more speedily brought to the knowledge of the astronomical public. The two memoirs next referred to have in fact already appeared in the new form; and the preface announces also the speedy publication of two other memoirs, by MM. Liapounov and O. Struve, on the great nebula of *Orion*.

Nouvelle Determination de la Parallaxe Annuelle des Etoiles α Lyræ et 61 Cygni. Par M. O. Struve, Mém. de l'Acad. de St. Pet. VII. Serie, t. i. No. 1.

The observations upon which these determinations are founded were made at the Pulkova Observatory in the years 1851–52, and an abstract of the memoir is published in the *Bulletins* of the Academy, t. xiii. (1855), p. 283, so that the results of the investigation have been for some years in the possession of astronomers. See also *Monthly Notices*, vol. xiii. p. 74, and vol. xiv. p. 159.

Pulkowaer Beobachtungen des Grossen Cometen von 1858. Erste Abtheilung, Beobachtungen am Refractor angestellt von O. Struve. Zweite Abtheilung, Beobachtungen am Heliometer nebst Untersuchungen ueber die Natur des Cometen von Dr. A. Winnecke. Mit sechs Tafeln. Gelesen am 29 Ap. 1859. Mém. de l'Acad. de St. Pet. VII. Serie, t. ii. No. 1 (1859).

The comet was first seen at Pulkova on the 16th August in the refractor, and with the naked eye on the 19th August; but, on account of the smoke from the burning of the morasses, no observations could be taken in that month; and the observations of position and configuration recorded in the memoir extend from the 2d Sept. to the 13th Oct. 1858. There are several elaborate drawings of the comet.

Librorum in Bibliotheca Speculæ Pulcovicensis Anno 1858 *exeunte contentorum Catalogus Systematicus:* Edendum curavit et præfatus est Otto Struve. Petropoli, 1860.

The Library of the Pulkova Observatory, in the year 1845, when the former Catalogue was published, comprised

2068 works, contained in 4150 volumes,
60 celestial charts, and
3109 memoirs and smaller works.

The present catalogue to the end of the year 1858 shows

4113 titles of works, contained in 7625 volumes,
143 celestial charts, and
14,634 titles of memoirs and smaller works;

but the titles of a large proportion of the memoirs are taken from Transactions of Societies and other collective works.

The Catalogue is divided into two parts; the former of

them (pp. 1–262 and 819–830) comprising the separate works (*libri majores*), and the latter (pp. 265–818 and 831–857) the memoirs, &c. (*libri minores et dissertationes*), and in each part the arrangement is a classified one, according to subjects; there being also to each of them an alphabetical index of authors' names. It might, perhaps, have been preferable to blend together these two indices. The arrangement is a most admirable one; and not only with respect to astronomy, but even as regards pure mathematics, the catalogue will be most valuable as a work of reference. If it were not that the work itself ought to be in the hands of all concerned, it would be worth while to exhibit the divisions and subdivisions of the subjects, as shown by the contents or *Systema Catalogi* (pp. xxv.–xxx.) of the introduction.

Anseinandersetzung einer zweckmässigen Methode zur Berechnung der absoluten Störungen der kleinen Planeten. Von P. A. Hansen (Abhandlungen der k. Sächs. Gesell. zu Leipsig. Erste Abh. t. v. pp. 44–218, 1856; Zweite Abh. t. vi. pp. 3–148, 1857; Dritte Abh. t. vii. pp. 83–335, 1859).

Only a short account can be given of these elaborate and important memoirs. The method is, in its general character, similar to M. Hansen's method in the lunar theory, viz. it is assumed that the longitude in orbit (departure) and the radius vector are functions, the former of the same form and the latter of the same form (except that the expression contains a variable factor which has to be determined) as in the elliptic theory, but instead of the mean anomaly there is a function z of the form $n\,t +$ periodic and secular terms, the expression for which has to be determined by the theory. The perturbations of the plane of the orbit are taken account of in a very elegant manner. The development of the disturbing function is effected in terms of the eccentric anomalies of the two planets: it is stated that a greater convergency of the series is thereby obtained. The values of the coefficients are found by the method of quadratures. The method is applied to the calculation of the perturbations of *Egeria*. The perturbations depending on the first powers of the masses of *Jupiter*, *Saturn*, and *Mars*, are obtained in the second memoir; those depending on the powers and products of the second order (viz. $(Jupiter)^2$ and $Jupiter \times Saturn$, which are considered as the only sensible cases) are obtained in the third and concluding memoir, which, as the author remarks, affords the first instance of the calculation of the perturbations of the second order for one of the small planets.

On the Secular Variations and Mutual Relations of the Orbits of the Asteroids. By Simon Newcomb. (Memoirs of the American Academy, New Series, t. v. pp. 123–135, Communicated 24th April, 1860.)

The following is an outline of this interesting memoir. The object is stated to be the examination of those circumstances of the forms, positions, variations, and general relations of the asteroid orbits, which may serve as a test, complete or imperfect, of any hypotheses which may be made respecting the cause from which they originated, or the reason why they are a group by themselves. Every *à priori* test is founded on the supposition that the hypothesis to be tested necessarily or probably implies that certain conditions must be fulfilled by the asteroids or their orbits. The tests consist in observing whether these conditions are fulfilled. The conditions may be divided into two general classes, — those which are rigorous and necessary, and those which are merely probable. The nature of the latter conditions appears from the examples which are subsequently given of their deduction from hypotheses.

Two hypotheses worthy of consideration have been promulgated respecting the origin of the asteroids: one (Olbers' hypothesis), that they are the fragments of a single planet, shattered by some unknown cause; the other, that they were formed by the breaking up of a revolving ring of nebulous matter.

To apply rigorous tests to either of these hypotheses it is necessary to have rigorous expressions in terms of the time, for the values of the excentricity, inclination, longitude of perihelion, and longitude of node of each asteroid used in applying the test. For the probable tests it is necessary to have the mean and the limiting values of the same elements; and to obtain these the same expressions are required.

The subject is arranged under the following heads:—

§ 1. Computation of the rigorous expressions in terms of the time, of the elements of the asteroids.

§ 2. On the possibility that the orbits of all the asteroids once intersected in a common point.

§ 3. Have the elements of the asteroid orbits ever been materially affected by a resisting medium?

§ 4. Of the relations among the mean distances, excentricities, and inclinations of the orbits of the asteroids; and between their masses and the velocities with which they must have been projected, if Olbers' hypothesis be true?

§ 5. Of certain observed relations among the asteroids which are the necessary or probable result of known causes, and, therefore, throw no light on the origin of the asteroids.

The investigations of § 1 are the mathematical basis of the memoir. The secular variations h, l ($= e \sin \varpi$, $e \cos \varpi$), and p, q ($= i \sin \Omega$, $i \cos \Omega$), of an asteroid, are to be deduced from the expressions given in the *Mécanique Céleste*, liv. ii. § 55 and 59. In these expressions h, l, are determined by linear differential equations, which involve (besides l, h) the corresponding quantities l', h', l'', h'', &c. for the disturbing planets, and in like manner p, q, are determined by linear differential equations, which involve (besides q, p) the corresponding quantities q', p', q'', p'', &c. for the disturbing planets. But the actions of the asteroids on each other, and on the larger planets, are neglected; l', h', p', q', &c. relate, therefore, to the larger planets, and are considered as known functions of the time,—the numerical values for the planets considered are taken from t. ii. of the *Annales de l'Observatoire de Paris*. The remaining quantities in the equations depend on the mean distance of the asteroid, and they are tabulated in the memoir for every ·05 in the value of the mean distance, between the limits 2·20 and 3·20, of the asteroids. The data are then applied to the asteroids the elements of which are determined with sufficient accuracy, and the excentricities and inclinations of which are sufficiently small; the latter class being presumed to include all those for which each of these elements is less than 11°; and in this manner expressions for h, l, p, q, in terms of the time, are obtained (pp. 133–137) for the asteroid,—*Ceres*, *Vesta*, *Astræa*, *Flora*, *Metis*, *Hygeia*, *Parthenope*, *Irene*, *Psyche*, *Thetis*, *Fortuna*, *Massilia*, *Lutetia*, *Themis*, *Proserpina*, *Euterpe*, *Bellona*, *Amphitrite*, *Urania*, *Pomona*, *Circe*, *Fides*, *Leda*, *Lætitia*, *Harmonia*.

From these expressions are deduced the following conclusions:—

1. *Harmonia* is the only asteroid among those the elements of which are well determined, the orbit of which can ever approach indefinitely near the circular form. *Doris* may possibly be found to be an additional asteroid in this class.

2. *Euterpe* is the only known asteroid the orbit of which can ever approach indefinitely near the invariable plane of the planetary system.

3. The perihelion of each asteroid (*Harmonia*, *Doris*, and *Euterpe*, only excepted) revolves nearly in the same time as its node, the time of revolution varying from about 15,000 to 40,000 years.

4. The excentricities and inclinations to the invariable plane, of the asteroids considered, cannot exceed the values given in the memoir for the same asteroids respectively.

§ 2. If Olbers' hypothesis be true the orbits must once have had a common point of intersection.

It appears that under the assumption of the investigation the orbit of *Hygeia* could never have intersected with that of *Vesta*, *Flora*, *Metis*, *Urania*, or *Harmonia*; and that the orbit

of *Psyche* could never have intersected with that of *Flora* or *Urania*. But as two asteroids might, by their mutual attraction if they came sufficiently near, change each other's mean distance very materially, the result cannot be considered as conclusive against the hypothesis, and it does not seem possible absolutely to disprove the hypothesis by an attempt at rigorous computations of the secular variations of the asteroids.

§ 3. The conclusion arrived at is that, if the motions of the asteroids are affected by a resisting medium, the former positions of some of the orbits were more unfavourable for a common point of intersection than their present ones.

§ 4. On all probable hypotheses on the cause of an explosion of a planet — the smaller fragments ought on the whole to be thrown off with a greater velocity than the larger ones. Moreover, when (as in the case of the asteroids) each fragment is small compared with the original mass, it seems at least highly probable that the velocities of those thrown off in any one direction would be very nearly the same on the whole as the velocities of those thrown off in a direction at right angles to that of the former one. There are thus two probable tests of Olbers' hypothesis. It appears that there is a remarkable agreement of the circumstances of the asteroids with the second test, and this favours Olbers' hypothesis, but no such relation exists as is supposed by the first test.

§ 5. The conclusion appears to be that certain peculiarities which have been observed as to the distribution of the perihelia and nodes of the asteroids, and other observed relations, do not furnish any argument for or against Olbers' hypothesis. But it has been suggested that the inclinations are usually small, because the asteroids are looked for near the plane of the ecliptic, and (this being so) it seems probable that the mean inclination of the whole number of the asteroids, known and unknown, is much greater than that of the known asteroids; and according to the author the fact, if so, furnishes an additional argument against the hypothesis of explosion.

Brünnow's Spherical Astronomy; translated by the Rev. R. Main. Part I., including the chapters on Parallax, Refraction, Aberration, Precession, and Nutation. Cambridge, 1860.

The excellence of the original work is well known; the translator remarks that the want of a text-book for Spherical Astronomy has been long felt at Cambridge and in the other universities of the British Isles in which the mathematical sciences are cultivated. And he hopes that the translation,

although incomplete, may be of considerable service, since, with the exception of the detailed accounts, given in the latter portion of the original work, of the construction and use of instruments and of the methods employed by modern astronomers for deducing from observations the most accurate values of the constants employed in Astronomy, the portion printed contains nearly the whole which would be valuable to English students; in particular, the theories of Parallax, Refraction, Aberration, Precession, and Nutation, are given in a more complete form than is to be found in any English work.

Tables for facilitating the Reduction of Lunar Observations. By C. F. A. Shadwell, Esq., C.B., Captain R.N., London, 1860.

The formulæ from which the lunar tables are derived were originally proposed by the late Lieut. Henry Raper, R.N., in the 18th volume of the *Monthly Notices*. The author remarks, "Rigorous, elegant, and concise, Raper's formula can scarcely fail to recommend itself to the notice of the scientific student—while the brevity and simplicity of the tables necessary for its practical application give the method of reduction derived from it great claims to the attention of the practical navigator."

The work is divided in two chapters; the first contains the theory of the method; the second, practical rules, with examples, illustrating their application. The tables are comprised in the concluding pages, 54–63, of the work. In Chapter I. the opportunity is taken to explain, and in some measure to criticise, the various rules and tables for solving the problem, depending on Lyons' formula, which have been published from time to time by various authors. It is remarked that Lyons' formula ranks high among the approximate methods which have been devised for solving the lunar problem; Raper's formula, however, while equally brief and quite as easy in numerical solution, has the advantage of affording a rigorous mathematical result; and that, while equally available at sea with other methods, it is therefore peculiarly suited for the reduction of lunar observations on shore, where extreme precision is required. It may be anticipated that the work will, as the author hopes, prove acceptable to practical navigators and scientific travellers, and be received as a useful contribution to nautical astronomy.

In the *Bulletins* of the 6th, 7th, and 8th Dec. 1860, M. Le Verrier gives an account of his "Théorie et Tables du Mouvement de *Venus*." The work is divided into five sections.

Section 1 is devoted to the perturbations of *Venus* by *Mercury*, the Earth, *Mars*, *Jupiter*, &c. All the terms which rise to the half-hundredth of a second are scrupulously taken account of. The long inequality depending on 13 times the mean motion of the Earth less 8 times the mean motion of *Venus*, the discovery whereof is due to Mr. Airy, has been determined anew, the approximation being carried to the terms of the seventh order as regards the excentricities and the inclinations. Among the terms depending on the second power of the disturbing force, that depending on 4 times the mean motion of *Mars* less 3 times the mean motion of *Venus* less 7 times the mean motion of the Earth, is sensible, as in the theory of the motion of the Earth. It has been determined with care. The formulæ for the secular inequalities of *Venus* show that the action of *Mercury*, taking the mass at $\frac{1}{3000000}$ of the mass of the Sun, amounts to two-thirds of the action of the Earth; it is thus very sensible, and the observations of *Venus* during the last century ought to conduct to a reliable determination of the mass, still so imperfectly known, of *Mercury*.

Section 2 contains the establishment of all the formulæ necessary in the theory of *Venus*.

In Section 3 are collected all the observations of *Venus* which are made use of. The more ancient observations are of no service; the available ones are:—1, a series of meridian observations from Bradley in 1750 to the present time; 2, observations of the transits of 1761 and 1769, and, to a certain extent, the transit of 1639; 3, a remarkable observation of an occultation of *Mercury* by *Venus*, made at Greenwich in the year 1737, and which some circumstances render very precious. The "Reduction of the Greenwich Observations of Planets from 1750 to 1830" has been largely made use of; and as the positions of the stars employed in the reductions are there given, M. Le Verrier has been able to introduce the modifications arising from his own discussion of Bradley's star-observations. As the precision of observation of the occultation of *Mercury* by *Venus* was unknown, this observation was not used in the determination of the elements of the tables, but it afforded a verification of the tables.

Section 4 contains the results of the comparison of the theory with the observations.

The recent observations give the elements of the motion of the planet at the present time; and the ancient ones, which give the mean motion, are also the only ones which can lead to the values of the disturbing masses of *Mercury* and the Earth. Taking the mean motion of the planet from the observations of the transits of 1761 and 1769, the mass of *Mercury* can only be deduced from the longitudes given by Bradley's meridian ob-

servations. And these lead to sufficiently precise results, from which it appears that the mass of *Mercury* should be reduced to about $\frac{1}{5\,0\,0\,0\,0\,0\,0}$ of the mass of the Sun, which agrees with the result obtained by M. Encke from his comet of short period.

The mass of the Earth is obtained chiefly from the observations of the latitude. The aggregate of the observations of the transits of 1761 and 1769 give a first equation, and a second one is deduced from the aggregate of Bradley's observations of the latitudes. These two equations agree in showing that the received mass of the Earth must be augmented by about *one-tenth* of its value — the lunar equation in the theory of the motion of the Earth had already shown that the mass of the Earth required to be considerably augmented.

Section 5 comprises the tables, xxxviii. in number, necessary for the calculation of the places of the planet. The tables satisfy all the known observations. They represent very well the aggregate of the meridian observations, and satisfy the observations of the transits, including that of 1639 in the limits of its accuracy. It appears, also, that using them concurrently with M. Le Verrier's tables of *Mercury* and of the Sun, to calculate the occultation of *Mercury* by *Venus* in 1737, the agreement affords a remarkable confirmation of the accuracy of the tables of the Sun, of *Mercury*, and of *Venus*.

The theory of *Venus*, based on the reciprocal action of the sun and the planets, presents no anomaly. The theory of Universal Gravitation, applied to known physical causes, gives a perfect account of the motion of the Earth and of *Venus*; more than this, it does the same with respect to *Mercury*, except as to a single point, the secular variation of the perihelion; and it is impossible to doubt (M. Le Verrier concludes) but that the ring of small planets interior to the orbit of *Mercury*, the consideration whereof is indispensable to remove this discrepancy, has a real existence.

Note sur les Inégalités Lunaires à longues Périodes dues à l'action perturbatrice de Vénus. Par M. Delaunay. (Extract.)

(*Communicated by the Astronomer Royal.*)

La discussion des observations de la Lune ayant amené les astronomes à admettre dans son mouvement l'existence d'une ou de plusieurs inégalités à longue période, on a cherché à en trouver la cause dans les actions perturbatrices auxquelles cet astre est soumis. C'est ainsi que M. Hansen a trouvé que l'action

de *Vénus* introduit dans la valeur de la longitude de la lune les deux inégalités suivantes:

$$+ 27''{\cdot}4 \sin (-l - 16\,l' + 18\,l'' + 35^\circ\,20'{\cdot}2)$$

(période de 273 années)

$$+ 23''{\cdot}2 \sin (8\,l'' - 13\,l' + 315^\circ\,20'),$$

(période de 239 années).

l, l', l'', étant respectivement les anomalies moyennes de la Lune, de la Terre, et de *Vénus*. La première de ces deux inégalités est produite par l'attraction directe de *Vénus* sur la Lune; en ne tenant compte que de la première puissance de cette action perturbatrice, M. Hansen avait trouvé $16''{\cdot}01$ pour son coefficient: c'est en poussant l'approximation jusqu'aux quantités de l'ordre du produit du cube de la force perturbatrice du soleil par la masse de *Vénus* qu'il a dû porter ce coefficient de $16''{\cdot}01$ à $27''{\cdot}4$. La seconde inégalité dépend en partie de l'attraction directe de *Vénus* sur la Lune, et en partie de cette attraction réfléchie par l'intermédiaire de la Terre; son argument est celui pour lequel M. Airy a montré le premier qu'il a un coefficient sensible dans le mouvement de la Terre. Ces résultats obtenus par M. Hansen ont été communiqués par lui à l'Académie des Sciences de Paris dans sa séance du 5 Mai, 1847; il annonçait en même temps qu'il se proposait de refaire le calcul des deux inégalités qu'il avait trouvées, parceque leurs coefficients ne lui paroissaient pas déterminés avec toute l'exactitude désirable.

M. Hansen revient sur ces inégalités à longues périodes produites par *Vénus*, dans une lettre adressé à M. Airy, au sujet de la construction de ses Tables de la Lune, et insérée dans les *Monthly Notices* (Novembre 1854). Voici ce qu'on y lit à l'occasion de la différence entre la valeur qu'il adopte pour le moyen mouvement de la Lune et celle que M. Airy avait précédemment obtenue: ". . . . This arises from the circumstance that I have slightly altered the coefficients of the two inequalities of long period. The accurate determination of these two inequalities by theory is the most difficult matter which presents itself in the theory of the moon's motion. I have on two occasions, and by different methods, sought to determine their values, but I have obtained results essentially different from each other." On trouve, en effet, dans le préambule des Tables de la Lune de M. Hansen, que les deux inégalités dont il est question y ont été introduites avec les valeurs suivantes:—

$$+ 15''{\cdot}34 \sin (-l - 16\,\mathrm{E} + 18\,\mathrm{V} + 30^\circ\,12')$$
$$+ 21''{\cdot}47 \sin (8\,\mathrm{V} - 13\,\mathrm{E} + 274^\circ\,14').$$

V designant la longitude moyenne héliocentrique et sidérale de

Vénus, E celle de la Terre, et l l'anomalie moyenne de la Lune. Les coefficients qui, comme on le voit, diffèrent notablement de ceux que M. Hansen leur avait d'abord attribués, et que nous avons rapportés plus haut, paraissent avoir été choisis de manière à satisfaire convenablement aux observations tant anciennes que modernes, et présentent ainsi un caractère purement empirique.

Ce point de la théorie de la Lune a dû naturellement attirer mon attention, en raison de l'incertitude qui en résulte sur la réalité de l'existence des deux inégalités trouvées par M. Hansen, ou au moins sur la grandeur de leurs coefficients. Je me suis donc occupé d'en effectuer moi-même la détermination, en profitant de mes recherches antérieures sur le mouvement de la Lune. L'objet de cette note est de faire connaître les résultats aux quels je suis parvenu.

Relativement à la première des deux inégalités de M. Hansen, les calculs aux quels je me suis livré m'ont conduit à une confirmation partielle de ses résultats. En m'en tenant d'abord à la première puissance de l'action perturbatrice de *Vénus* sur la Lune, j'ai trouvé pour cette inégalité

$$+ 16''{\cdot}024 \sin (-l - 16\,l' + 18\,l'' + 35^\circ\,20'{\cdot}2),$$

valeur identique avec celle que M. Hansen avait obtenue dans le même cas. Mais ensuite, en poussant les approximations plus loin, c'est à dire en allant jusqu'aux quantités de l'ordre du produit de la masse de *Vénus* par le cube de la force perturbatrice du soleil dans les termes indépendents de l'inclinaison de l'orbite de *Vénus* sur l'écliptique, et jusqu'aux quantités de l'ordre du produit de la masse de *Vénus* par la cinquième puissance de la force perturbatrice du soleil dans les termes qui dépendent de cette inclinaison, je n'ai obtenu qu'une très-légère modification à mon premier résultat: j'ai trouvé pour l'inégalité

$$+ 16''{\cdot}336 \sin (-l - 16\,l' + 18\,l'' + 35^\circ\,16'{\cdot}5).$$

Ainsi les approximations ultérieures n'ont fait qu'augmenter son coefficient de $0''{\cdot}312$. La détermination numérique de cette inégalité a été faite en adoptant, comme M. Hansen, $\frac{1}{408134}$ pour le rapport de la masse de *Vénus* à celle du soleil. Si l'on prenait pour ce rapport la valeur plus grande $\frac{1}{400000}$ qui parait mieux s'accorder avec les perturbations produites par *Vénus*, le coefficient de l'inégalité dont nous nous occupons devrait être porté de $16''{\cdot}336$ à $16''{\cdot}668$.

Le résultat auquel je suis arrivé pour la seconde des inégalités de M. Hansen est tout différent: au lieu des coefficients $23''{\cdot}2$ et $21''{\cdot}47$ qui M. Hansen lui a attribués successivement, j'ai trouvé que son coefficient est à peu près nul. Suivant lui, cette inégalité est due en partie à l'attraction directe de *Vénus*

sur la Lune, et en partie à cette attraction réfléchie par l'intermédiaire de la Terre. J'en ai effectué la détermination en tenant compte de ce double mode d'action de la planète troublante. La partie de cette inégalité qui provient de l'attraction de *Vénus* réfléchie par l'intermédiaire de la Terre, résulte de l'existence de l'inégalité de même argument trouvée par M. Airy dans le mouvement de la Terre autour du soleil; j'ai pu facilement m'assurer qu'elle ne s'élève pas à $\frac{1}{3}$ de seconde. Quant à la partie de l'inégalité en question qui est due à l'action directe de *Vénus* sur la Lune, j'en ai fait le calcul en poussant les approximations assez loin pour ne pas craindre d'obtenir un résultat inexact, et j'ai reconnu qu'elle est absolument insensible.

D'après ce qui précède, la première des deux inégalités lunaires à longues périodes dues à l'action perturbatrice de *Vénus* doit seule être prise en considération dans les Tables; et son coefficient, qui je trouve égal à $16''{\cdot}668$, diffère peu de celui ($15''{\cdot}34$) auquel M. Hansen s'est arrêté pour satisfaire convenablement aux observations.

Le mémoire dans lequel j'ai développé en détail les calculs relatifs à la première inégalité, a été imprimé dans les *Additions à la Connaissance des Temps pour* 1862. Un second mémoire, contenant tous les détails du calcul de la seconde inégalité, paraîtra incessamment.

Note by the Astronomer Royal.

As several allusions have lately been made to the degree of empiricism in Professor Hansen's determination of the coefficients of the two long inequalities of the moon produced by the disturbing force of *Venus*, to which Professor Hansen has adverted in his letter of 1854, Nov. 3 (of which letter a translation is printed in the *Monthly Notices* of 1854, Nov. 10), I think it desirable to give the original of the most important sentence, and to annex what appears to be a correct translation.

The original is —

"In meinen Mondtafeln habe ich einstweilen Coefficienten angewandt, die nicht frei von einigen Empirismus sind."

The correct translation appears to be —

"In my Lunar Tables I have provisionally applied coefficients which are not free from some empiricism."

Royal Observatory, Greenwich,
1860, *December* 28.

CONTENTS.

Page

Fellow elected 41

On a Method for determining Longitude by means of observations on the Moon's greatest Altitude, by Mr. Spottiswoode ... ... ib.

On the Distribution of the Perihelia of the Parabolic Comets in relation to the Motion of the Solar System in Space, by Mr. Carrington 42

On some Formulæ relating to the Variation of the Plane of a Planet's Orbit, by Mr. Cayley 43

Observations of Comet III. 1860, by Mr. Scott, Director of the Observatory of Sydney 46

Results of Meridional Observations of Small Planets, and Occultation of *Jupiter's* third Satellite, observed at the Royal Observatory, Greenwich, during the month of November 1860 48

Elements of Minor Planet (60) 49

Drawings of Solar Spots, by Rev. F. Howlett 50

Photographs of the Sun during the Solar Eclipse of July 18, 1860, by M. Monserrat 51

Drawings of Nebulæ by Mr. Lassell ... ... ib.

Recent Publications:—

Recueil de Mémoires des Astronomes de l'Observatoire Centrale de Russie, publié avec l'autorisation de l'Académie des Sciences, t. II 52

Nouvelle Determination de la Parallaxe Annuelle des Etoiles *α Lyræ* et 61 *Cygni*, by M. O. Struve 53

Pulkowaer Beobachtungen des grossen Cometen von 1858 ... ib.

Librorum in Bibliotheca Speculæ Pulcovicensis Anno 1858 exeunte contentorum Catalogus Systematicus ... ... ib.

Anseinandersetzung einer zweckmässigen Methode zur Berechnung der absoluten Störungen der kleinen Planeten, by M. Hansen 54

On the Secular Variations and Mutual Relations of the Orbits of the Asteroids, by Mr. Newcomb 55

Brünnow's Spherical Astronomy, translated by the Rev. R. Main 57

Tables for facilitating the Reduction of Lunar Observations, by Capt. Shadwell, R.N. 58

Théorie et Tables du Mouvement de *Venus*, by M. Le Verrier ... 59

Note sur les Inégalites Lunaires à longues Périodes dues à l'action perturbatrice de *Vénus*, by M. Delaunay 60

Printed by STRANGEWAYS and WALDEN (late G. Barclay), Castle St. Leicester Sq. and Published at the Apartments of the Society, January 9, 1861.